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THESIS

PREDICTING SPACE REQUIREMENTS AT DEFENSE LOGISTICS AGENCY WAREHOUSES

by

Walter A. Grauer

September, 1996

Co-Advisors:

David G. Brown
Kevin R. Gue

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**PREDICTING SPACE REQUIREMENTS AT
DEFENSE LOGISTICS AGENCY WAREHOUSES**

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Submitted in partial fulfillment
of the requirements for the degree of

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ABSTRACT

The Defense Logistics Agency (DLA) currently operates all of the military's Defense Depots, storing millions of cubic feet of material. We compare DLA's storage capacity over the next three years to the demand placed on it by the military – specifically the Service's baseline inventory level plus material returned by deactivated or decommissioned units and ships. We show that DLA will have sufficient storage capacity for fiscal years 1997 - 1999.

TABLE OF CONTENTS

I.	INTRODUCTION	1
A.	AREA OF RESEARCH	1
B.	RESEARCH QUESTIONS	2
C.	PURPOSE	2
D.	METHODOLOGY	3
II.	BACKGROUND	5
A.	OVERVIEW	5
B.	DEFENSE LOGISTICS AGENCY	8
C.	DEFENSE MANAGEMENT REVIEW DECISION 902	8
D.	BASE REALIGNMENT AND CLOSURE	9
E.	U.S. MILITARY DRAWDOWN	10
III.	AVAILABLE DLA WAREHOUSE SPACE - THE NEXT 3 YEARS	13
A.	MEASURING WAREHOUSE SPACE USE	13
1.	Storage vs. Non-Storage Space	14
2.	Measuring Gross Storage Area	14
3.	Measuring Covered Storage Space	14
4.	Measuring Open Storage Areas	14
5.	Calculating Gross Space for Storage Operations	15
6.	Calculating Net Storage Space	15
7.	Calculating Net Storage Capacity	15
8.	Storage Space Reporting	16

B.	REDUCTION IN AVAILABLE STORAGE SPACE DUE TO BRAC . . .	17
C.	TOTAL AVAILABLE DLA STORAGE SPACE	17
IV.	DLA WAREHOUSING STORAGE REQUIREMENTS	21
A.	BASELINE DOD STORAGE REQUIREMENTS	21
1.	Assumptions	21
2.	Baseline Inventory in Cubic Feet	22
B.	MILITARY FORCE STRUCTURE CHANGES	24
1.	Overview	24
2.	Army	26
3.	Navy	27
4.	Air Force	28
5.	Marine Corps	28
C.	MATERIAL RETURNED TO DLA DUE TO FORCE STRUCTURE CHANGES	28
1.	Overview	28
2.	Navy	29
V.	AVAILABLE STORAGE SPACE VERSUS STORAGE REQUIREMENTS .	33
VI.	SUMMARY	37
A.	SUMMARY	37
B.	RECOMMENDATIONS	39
C.	AREAS FOR FURTHER RESEARCH	39
	LIST OF REFERENCES	43

INITIAL DISTRIBUTION LIST	45
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LIST OF FIGURES

1. From GAO/NSIAD-95-64. Locations of DLA Distribution Depots	5
2. DLA Storage Area Capacity (NSF and GSF)	19
3. DLA Storage Volume Capacity (ACF)	20
4. DoD Baseline Inventory	24
5. Capacity vs. Requirements	35
6. Capacity Utilization	36

LIST OF TABLES

1. Historical DoD Storage Requirement	7
2. BRAC Closures and Realignment FY91 - FY95	10
3. Storage Space Measures at Activities Being Closed by BRAC	18
4. DoD Baseline Inventory	23
5. Overview of U.S. Military Force Structure FY 1995 - 1999	25
6. Total Number of U.S. Navy Ship Decommissionings	27
7. Number of Returned Material Lifts and Resulting Volume by Decommissioning Ship Type	30
8. Ships Scheduled for STRIKE by Type and Fiscal Year	31
9. Expected Material Offloads (in CF) by Ship Type and Fiscal Year	31
10. Comparison of Factors Impacting DLA Storage: Earliest Closure of Depots . .	34
11. Comparison of Factors Impacting DLA Storage: Latest Closure of Depots . . .	34

I. INTRODUCTION

A. AREA OF RESEARCH

The Defense Logistics Agency (DLA) is the principal combat support agency of the Department of Defense (DoD). One of DLA's primary functions is the storage and distribution of 6.1 million items of supply valued at \$105.7 billion (DTJ, 1996, p. 16).

This is accomplished by approximately 10,000 employees working at 24 distribution sites and at an annual cost of over \$1.5 billion (GAO, 1995, p. 2). To accomplish its storage function, DLA must ensure that warehouse capacity exceeds future inventory levels.

Currently there is an excess of capacity; however, the closure of bases and the decommissioning and deactivation of military units over the next three years will increase the demand for DLA warehouse space.

As the military constricts to meet the force structure levels mandated by President Clinton's Bottom Up Review (BUR), there is increasing pressure to reduce the amount of warehouse space used by the DoD's primary warehouse manager, DLA. The Base Realignment and Closure (BRAC) process from 1988 - 1995 closed bases and depots, thereby reducing the warehouse space available for DLA to store material. At the same time, the downsizing of the U.S. military has resulted in the return of secondary items (spare and repair parts, clothing, medical supplies, and other items) which add to the material DLA is required to store. This additional material results from ready for issue (A-condition) material that is returned to the supply system by decommissioned or deactivated units.

DLA's Distribution Directorate has looked at the effects of downsizing on storage

and distribution operations with respect to loss of storage sites due to BRAC, inventory reductions by both DLA and the services, European retrograde/force drawdown, maximizing cube utilization, and material outside that requires inside storage. One area that has not been considered is material returned by decommissioned or deactivated units. We include this material and compare projected available DLA warehouse space to the projected quantity of material to be stored over the next three years.

B. RESEARCH QUESTIONS

We address the following questions: (1) Over the next three years will DLA have enough warehouse space to meet its anticipated storage requirements? (2) Taking into account the BRAC process, how can we estimate the amount of warehouse space DLA will have over the next three years? (3) Considering the U.S. military downsizing, how can we estimate the amount of warehouse space DLA will need to accommodate anticipated requirements over the next three years?

C. PURPOSE

We divide the study into three sections: First, we estimate DLA warehouse space availability for the next three years including any lost space due to downsizing. Second, we estimate the amount of material DLA will be required to store over the next three years. This includes the material DLA stores during normal business operations, as well as additional material acquired from military downsizing. Finally, we determine the effect of returned material due to military downsizing on DLA's storage requirements over the next three years.

We calculate DLA's space losses due to BRAC by subtracting lost warehouses

from the current total and adding in new construction. Next, we convert force structure reductions into material returned to stock. Finally, we estimate the impact of space loss and stock influx on the DLA distribution operation.

D. METHODOLOGY

The methodology of this thesis calculates the storage capacity and storage requirements of DLA's Distribution Directorate through FY 1999. First, we use DoD's physical measures of storage space to estimate DLA storage space lost due to the BRAC process and to calculate DLA's remaining storage capacity. Then, we use DoD's baseline inventory, force structure projections, and decommissioned/deactivated unit spare parts volumes to estimate the volume of material returned to DLA through 1999. Finally, we compare the projected storage capacity to the projected storage requirement.

In order to obtain reference material which could not be found in available documents, we conducted personal and telephone interviews with distribution personnel at DLA Headquarters, DLA's Defense Distribution Region West (DDRW), each of the four service headquarters, and personnel directly involved with the return of material due to ship decommissions.

II. BACKGROUND

A. OVERVIEW

In April 1990, Defense Management Review Decision (DMRD) 902 directed that the military services consolidate their supply depot distribution operations for general supplies under DLA, effectively making DLA the warehouse manager for the DoD. DLA's distribution network is divided into two regions, containing 23 depots and one site, hundreds of warehouses, and storing approximately 6.1 million line items. The depot locations are presented in Figure 1. The material stored at these depots varies from clothing to microchips to construction equipment.

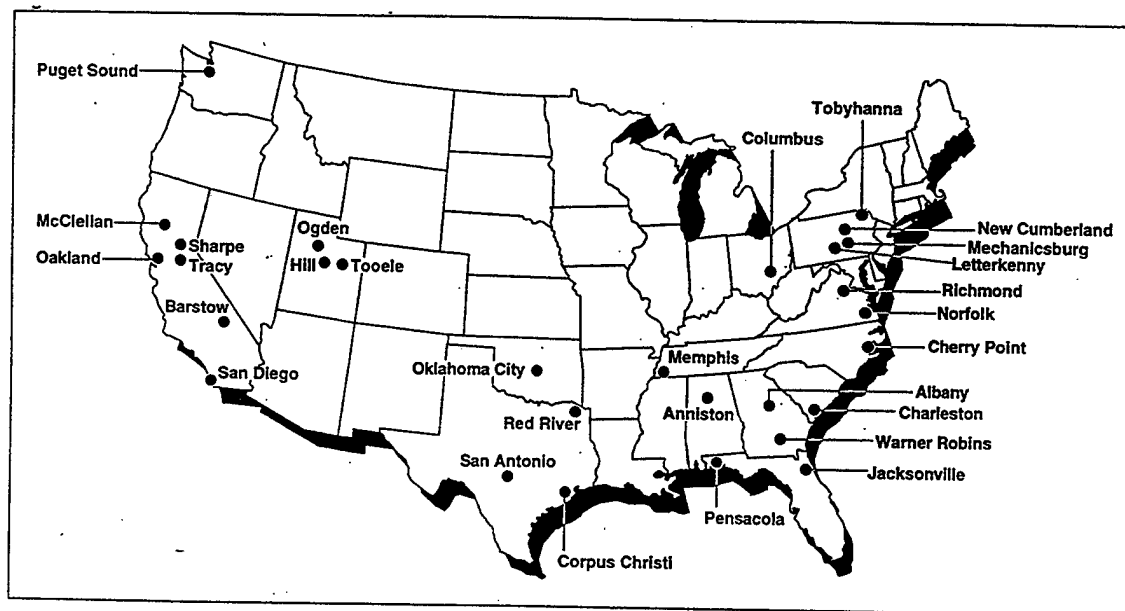


Figure 1. Locations of DLA Distribution Depots. From GAO/NSIAD-95-64.

The DoD has gone through the Base Realignment and Closure (BRAC) process four times since 1988. Many of the closed bases have DLA warehouses on them. For

example, the Fleet and Industrial Supply Center Oakland, CA and McClellan AFB, CA are Navy and Air Force installations that contain thousands of square feet of DLA warehouse space. In addition, the 1995 BRAC was the first one to close a DLA depot – Defense Depot Ogden, UT.

DLA warehousing has also been affected by the drawdown of the U.S. military that has been ongoing since the end of the Cold War. The decommissioning of Navy ships and squadrons, deactivation of Army divisions and Air Force wings, and the return of troops stationed overseas has resulted in the return of large quantities of A-condition (ready for issue) material to DLA.

The DLA Distribution Directorate's Storage Policy Team makes a tradeoff between filling warehouses to their maximum capacity and optimizing them for ease of order picking. DLA sets warehouse storage capacity goals based on the storage area of a distribution site in square feet. The minimum capacity goal is 55 - 60 percent full and the maximum is 85 percent full. Therefore, DLA is faced with effectively using their storage space while at the same time leaving enough open space for aisles, material handling equipment paths, and packaging.

In March 1996 the DLA system average was 44 percent capacity utilization or an occupied square footage of 37.3 million square feet (MSF) out of a capacity of 84.7 MSF. The 44 percent usage rate is lower than the goal of 55-60 percent and is indicative of excess capacity. This is the reason BRAC 1995 closed a DLA Defense Depot.

The measure of capacity used in this study is the DLA system wide cubic foot usage rate. There is no DLA capacity goal for cubic foot usage. However, the volume

measure is a better indicator of storage capacity and future storage requirements. The amount of cubic feet (CF) occupied by inventory and DLA's capacity are presented by fiscal year in Table 1. The numbers represent a 32 percent inventory reduction and a 19 percent storage capacity reduction in the five years DLA has been the DoD's warehouse manager.

**Table 1. Historical DoD Storage Requirement
(numbers are in 000's of CF)**

Fiscal Year	Inventory	Capacity	Percent Utilized
1992	631	788	80
1993	541	738	73
1994	450	618	73
1995	440	628	70
1996 (est)	430	641	67

(DLA, 1995)

The cube utilization rate is higher (67 percent) than the area utilization rate (44 percent) due different measuring standards. Cube utilization is the cubic space available for storage with existing resources. The percentage can be boosted by having more load limitations such as weaker floors or shorter reaching material handling equipment (MHE). For example, a warehouse where the MHE could stack material only ten feet high would have a usable cubic space much smaller than a warehouse where the MHE could stack material twenty feet high. The area utilization rate is based on the total storage area and can even include warehouse office space. Thus the area utilization rate includes more floor space than the cube rate includes.

B. DEFENSE LOGISTICS AGENCY

Soon after World War II, a presidential commission chaired by former President Herbert Hoover recommended centralizing management of common military logistics support and introducing uniform financial management practices. In 1961, after at least nineteen failed attempts to establish such an agency, Secretary of Defense, Robert S. McNamara, announced the establishment and objectives of the Defense Supply Agency. (Robinson, 1993, p. 2)

Headquartered at Fort Belvoir, Virginia, DLA's mission is to provide support to the armed forces, in peace and war, and assist in relief efforts during national emergencies. To do this DLA provides supply and distribution support, contract administration services, and technical and logistics services to all branches of the military. (DTJ, 1996, p. 16)

In the past, each service had its own supply system to store and manage supply materials. Today the individual services (Army, Navy, Air Force, Marines) manage only their service unique, critical repair parts. In contrast, the vast majority (almost 90%) of the material used by the military is managed, stored and distributed by DLA. (DLA Webpage, 1996)

The trend toward more DLA management means that over time the Defense Distribution System and the DLA Distribution System have become the same. Therefore this thesis will, for the most part, concentrate on DLA and leave the distribution systems of the individual services for later research.

C. DEFENSE MANAGEMENT REVIEW DECISION 902

In April 1990, Defense Management Review Decision (DMRD) 902 directed that

all military service and DLA supply depot distribution operations for general supplies be consolidated under DLA. (Nichols, 1991, pp. 1-3) This caused a great deal of consternation on the part of the services as they lost hands on control of "their material." The justification behind then Secretary of Defense Richard Cheney's decision to consolidate was that it will "permit [DoD] to position stock more efficiently, develop a single automated data processing system, consolidate transportation functions and facilities and reduce administrative costs." (OSD, 1991, p.2)

D. BASE REALIGNMENT AND CLOSURE

As the Cold War came to a close, the public expected that there be a corresponding reduction in the U.S. Military infrastructure. In 1988 the first Base Realignment and Closure Act was passed. It closed 36 major Army, Navy, and Air Force installations and realigned 7 others. (Defense BRAC, 1995)

Subsequent to the 1988 BRAC, laws were passed to regulate the process. The Defense Base Closure and Realignment Act of 1990 and Section 2687 of Title 10, United States Code, established requirements and procedures for base realignments and closures within the DoD. The Act and related policy guidance from the Office of the Secretary of Defense (OSD) and Joint Cross Service Groups form the groundwork for the Base Realignment and Closure (BRAC) analysis process which DLA follows. (DLA, 1995, p. 1.1)

The BRAC's of 1991, 1993, and 1995 closed or realigned several additional major and minor installations. Per Section 2687 of Title 10, United States Code, the BRAC process applies to the closure of any military installation with at least 300 civilian

personnel. Realignment is any action which both reduces and relocates functions and civilian personnel positions, but does not include a reduction in force. The distinction between major and minor bases is not listed in the BRAC process or U.S. Code. An example of a major base closure is the Defense Depot Memphis, TN with 3,349 jobs. While the Defense Depot Letterkenny, PA with 748 jobs is considered a minor base closure. A summary of BRAC actions for 1991, 1993, and 1995 are presented in Table 2.

Table 2. BRAC Closures and Realignments FY91 - FY95

Base Actions	BRAC 1991	BRAC 1993	BRAC 1995
major closure	36	28	27
major realignment	39	13	21
minor closure	0	122	12
minor realignment	0	4	45

(Navy BRAC, 1996)

E. U.S. MILITARY DRAWDOWN

External factors must be taken into consideration when DLA submits base realignment and closure recommendations with supporting rationale to the Secretary of Defense in the BRAC process. Because of the breadth of DLA's customer support, it is necessary to consider projected DoD force structure impacts in terms of the types of support or services provided by DLA. For distribution depots the force structure affects the number of items managed, the number of issues made, and the amount of material flowing through the system. (DLA, 1995, p. 3.1)

The Bottom Up Review was undertaken in 1993 by then Secretary of Defense Les Aspin as a deliberate way to improve long-term military readiness, modernize the military,

and ensure that taxpayer dollars are spent in the most efficient way possible. (Defense BRAC, 1995, ES-1)

The Storage Policy Teams at DLA Headquarters and at Defense Distribution Regions East (DDRE) and West (DDRW) make policy decisions based on the estimated impact of force structure changes. First, when recommending activities to close, the DLA BRAC 95 process considered the impact of the reduced DoD force structure on the types of support provided by DLA contract management, supply management, and distribution management. (DLA, 1995, p. 3.1)

Second, the Storage Policy Team used the BRAC commission mandated Cost of Base Realignment Actions (COBRA) model to determine if the combined impact of the drawdown and BRAC on DLA's distribution system could be accommodated (DLA, 1995, p. 4.1). Their analysis of DLA's storage requirement compared estimated inventory (in cubic feet) versus estimated capacity (in cubic feet). This analysis took into consideration force structure downsizing, DoD inventory reduction in dollars, and reductions in occupied cubic feet.

The DLA Storage Policy Team did not attempt to quantify and add in to the inventory the expected gains in material from ready for issue (A-condition) material turned in by decommissioned and inactivated forces. (Jennings, 1996) This study estimates these gains and their impact on DLA storage requirements.

III. AVAILABLE DLA WAREHOUSE SPACE - THE NEXT 3 YEARS

There are three areas that must be discussed when trying to understand DLA's warehousing situation: measuring warehouse space use, reduction of available storage space due to BRAC, and the resulting total available DLA storage space.

A. MEASURING WAREHOUSE SPACE USE

In a December 1994 memorandum to the service Deputy Chiefs, the Assistant Deputy Under Secretary of Defense (Material and Distribution Management) said, "Storage space information is becoming increasingly vital to DoD decisions regarding infrastructure reductions, stock positioning, and reduced logistics response times." He emphasized the need for timely and more detailed input. Furthermore, to increase DoD level visibility of covered storage space, the cutoff for submitting the semi-annual report was lowered from facilities having more than 1 million square feet to those having 200,000 square feet. As further proof of their importance in the area of defense distribution, these reports are submitted to DLA's Depot Operations Support Office at DLA Headquarters. (Jones, 1994, p. 1)

The method for measuring and reporting warehouse space use is described in detail in the Joint Service Manual (JSM) for Storage and Materials Handling (TM 38-400, NAVSUP PUB 572, AFMAN 23-210, MCO 4450-14, DLAM 4145.12). The manual explains how to (1) classify storage and non-storage space, (2) measure covered storage space, (3) measure open storage areas, (4) calculate gross space for storage operations in square feet, (5) report net storage space, and (6) submit storage space reports. The remainder of this section will give an overview of these six areas from the manual

1. Storage vs. Non-Storage Space

Space at an installation can be classified into storage and non-storage space. While this sounds simple it is actually very important to the calculations. The distinction means that not all of the building or all of the open areas are considered in computing actual storage space. For example, buildings such as the commissary, public works, administrative offices, and open areas such as parking lots are not considered storage space. The only area of an installation that is reported as storage space is that which is either by nature or use a storage area. For example, warehouses and open storage (outside) are considered storage space.

2. Measuring Gross Storage Area

Gross storage area is the sum of an installation's covered storage space, improved open storage areas, and occupied but unimproved open storage areas.

3. Measuring Covered Storage Space

Covered storage space is the width in feet multiplied by the length in feet, which results in the square foot area – the total gross storage area. (Covered storage space is measured by using inside dimensions.) Several areas are excluded from the total covered storage area: fire walls, passageways, ramps, stairwells, cutbacks in walls of the building, and offices (or any portion) not designed for storage. The resulting area is the one being used for storage purposes during the period of the report.

4. Measuring Open Storage Areas

Open storage areas are first broken down into improved and unimproved storage.

Improved is included in total gross storage area; but for unimproved, only that space actually occupied by stored material or in support of operations will be reported. Since by definition this space is 100 percent utilized, it can significantly boost an activity's space utilization.

5. Calculating Gross Space for Storage Operations

Once the space is classified and preliminary measurements are completed, the next step is calculating the gross space for storage operations in square feet in three steps: (1) calculate gross storage space, (2) subtract all space not used for storage operations, and (3) add ingranated space; that is, space which is leased, licensed, or permitted from one of the DoD Components. The formula for gross space for operations is:

$$\begin{array}{l} \text{GROSS SPACE} \\ \text{FOR STORAGE} \\ \text{OPERATIONS} \end{array} = \begin{array}{l} \text{GROSS} \\ \text{STORAGE} \\ \text{SPACE} \end{array} - \begin{array}{l} \text{SPACE NOT USED} \\ \text{FOR STORAGE} \\ \text{OPERATIONS} \end{array} + \begin{array}{l} \text{INGRANTED} \\ \text{SPACE} \end{array}$$

6. Calculating Net Storage Space

The net storage space in square feet is calculated by subtracting aisles, structural loss, and support space from gross space for storage operations. The formula for net storage space is:

$$\begin{array}{l} \text{NET STORAGE SPACE} \end{array} = \begin{array}{l} \text{GROSS SPACE} \\ \text{FOR STORAGE} \\ \text{OPERATIONS} \end{array} - \begin{array}{l} \text{(AISLES,} \\ \text{STRUCTURAL LOSS,} \\ \text{SUPPORT SPACE)} \end{array}$$

7. Calculating Net Storage Capacity

The net storage capacity in cubic feet is broken down into two classifications: total cubic feet and attainable cubic feet. Total cubic feet is the product of net storage space and the unobstructed storage stacking height(s) permitted by safety regulations in a

particular storage area. The formula for total cubic feet is:

$$\begin{array}{rcccl} \text{TOTAL} & & \text{NET STORAGE} & & \text{UNOBSTRUCTED} \\ \text{CUBIC} & = & \text{SPACE} & \times & \text{STORAGE} \\ \text{FEET} & & & & \text{HEIGHT(S)} \end{array}$$

Attainable cubic feet (ACF) is the cubic space usable or available for storage with existing resources. It is calculated by multiplying net storage space by the stacking height(s) permitted by safety regulations and floor load limitations with available MHE. The formula for attainable cubic feet is:

$$\begin{array}{rcccl} \text{ATTAINABLE} & & \text{NET STORAGE} & & \text{ATTAINABLE} \\ \text{CUBIC} & = & \text{SPACE} & \times & \text{STORAGE} \\ \text{FEET} & & & & \text{HEIGHT(S)} \end{array}$$

8. Storage Space Reporting

The Assistant Secretary of Defense for Logistics requires storage space reports be submitted to DLA, which has been designated as the DoD Storage Space Reporting Administrator (SSRA). The reports are submitted semiannually in June and December on the Storage Space Management Report, DD Form 805. This intricate spreadsheet contains four sections; (1) Gross Available Space, (2) Net Space Available, (3) Occupied Storage Space, and (4) Remarks.

Particularly important categories contained in the Storage Space Management Report are:

- a. Net Square Feet (NSF) - Floor area which is actually occupied by material plus the entire bin and rack areas less aisles.
- b. Gross Square Feet (GSF) - Floor area plus the entire bin and rack areas less aisles.

- c. Attainable Cubic Feet (ACF) - The amount of the total cubic feet that is attainable or usable. (DLA, 1995, p. 32)

B. REDUCTION IN AVAILABLE STORAGE SPACE DUE TO BRAC

In April 1990 DRMD 902 mandated consolidation of the military's supply depot distribution operations under DLA. DLA obtained control of the 32 depots in CONUS in 1992. Since then, BRAC 93 has closed five depots and BRAC 95 has slated four more depots for closure (Osborn, 1996). In addition, BRAC 93 and BRAC 95 have closed bases that are directly supported by co-located DLA depots. Due to these closures there have been an additional six depot reductions. In summary, the reduction will result in leaving the number of CONUS depots in the year 2001 at 17.

As of late 1996, DLA is in the midst of absorbing significant cuts in warehouse space as a result of the above BRAC actions. Six CONUS depots mentioned above and four storage sites in the process of being closed over the next five years account for nearly a third of DLA's available storage space. The storage space cuts are presented in Table 3. (DLA, 1995, p. 1.4)

C. TOTAL AVAILABLE DLA STORAGE SPACE

When the effects of the above BRAC and DLA actions are combined, we arrive at projected total available DLA storage space. However, these closure actions are

**Table 3. Storage Space Measures at Activities Being Closed by BRAC
(numbers are in 000s)**

Activity	NSF	GSF	ACF Covered	ACF Open	Occupied Open CF	Earliest Closure	Latest Closure
DD Pensacola	153	437	1,984	960	262	FY96	FY96
DD Memphis	2,021	4,800	31,133	17,350	5,292	FY97	FY97
DD Ogden	2,407	5,897	32,889	16,370	2,680	FY97	FY97
Alameda Site	228	392	2,731	608	184	FY97	FY97
Long Beach Facility	173	437	1,906	1,843	692	FY97	FY97
DD McClellan	740	2,513	12,790	4,080	2,650	FY97	FY01
DD San Antonio	1,639	4,102	25,917	13,859	3,483	FY97	FY01
Rough & Ready Site	1,245	2,119	15,180	4,777	171	FY98	FY98
DD Letterkenny	2,057	3,370	25,339	26,062	7,675	FY98	FY00
Piketon Site	161	304	2,415	0	0	FY99	FY00
Closure Total	10,824	24,371	152,284	85,909	23,089		
DLA Total (FY96)	37,359	84,667	565,694	302,745	94,632		
PCT of DLA Total	29%	29%	27%	28%	24%		

(DLA, 1996, p. 57)

phased by fiscal year (FY) and will not occur all at the same time. The year in which a base will close is not often firm because of the inability of the services to fund BRAC actions and political actions to privatize some closing maintenance facilities. (Kelleher, 1996)

The best estimates of available DLA storage space using the data from Table 3 are summarized in Figures 2 and 3. In Figure 2, DLA's remaining NSF and GSF are shown using first the earliest closure date and then the latest activity closure dates from Table 2. In Figure 3, DLA's remaining ACF for covered and open storage space is graphed versus time using (as in Figure 2) the earliest and latest activity closure dates from Table 3.

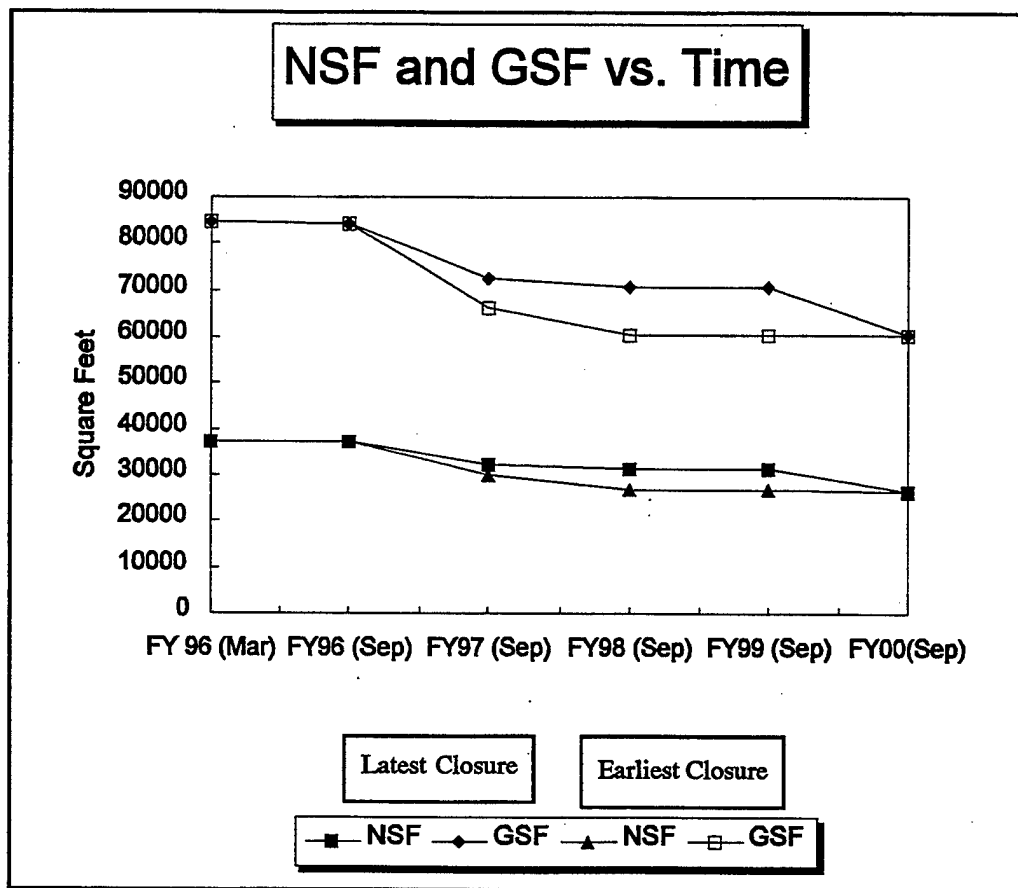


Figure 2. DLA Storage Area Capacity (NSF and GSF)

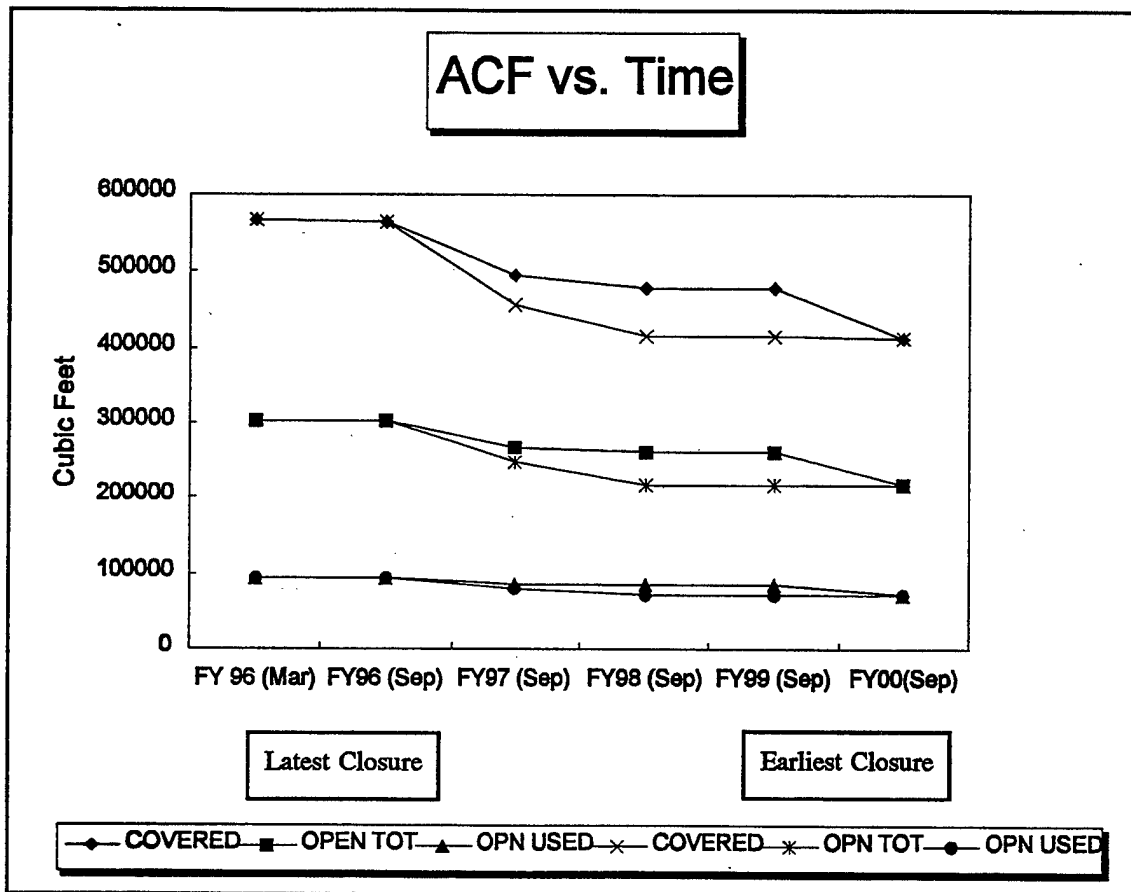


Figure 3. DLA Storage Volume Capacity (ACF)

IV. DLA WAREHOUSING STORAGE REQUIREMENTS

We describe two aspects of DLA's warehousing storage requirements: the baseline DoD storage requirements and material returned as part of DoD's force structure changes.

A. BASELINE DOD STORAGE REQUIREMENTS

1. Assumptions

DLA Headquarter's baseline storage requirements are based on the following assumptions, which are contained in the Defense Logistics Agency Base Realignment and Closure Detailed Analysis of February 1995 (DLA, 1995, p. 8.4) and were confirmed via interview in late 1996 (Sears, 1996):

a. *52% Reduction in DLA Inventory Control Point (ICP) Inventory Value.* This amounts to a 60% reduction (in cubic feet) in DLA's storage requirement for DLA managed items. The reduction is due to aggressive actions by DLA inventory control points (ICPs) to dispose of obsolete and excess material and to pursue innovative agreements with suppliers and customers that include Direct Vendor Delivery (DVD), Prime Vendor Arrangements, and Buy Response vs. Inventory Contracts. In the past four years DLA has reduced its inventory from 303 million cubic feet (MCF) in FY 1992 to 202 MCF at the end of FY 1995 – a 33 percent reduction. DLA managed items make up 45 percent of DLA's cubic storage requirement.

b. *47% Reduction in Service Inventory Value.* This corresponds to a 60% reduction (in cubic feet) in DLA's storage requirement for service ICP managed items. It is based on actions to dispose of obsolete material and use direct procurement actions.

In the last four years the services have reduced their inventory from 328 MCF in FY 1992 to 238 MCF at the end of FY 1995 – a 27 percent reduction. At the same time, the need to support new systems has added 19 percent to DLA's projected storage requirements.

c. *European Retrograde/Force Drawdown*. When completed this will increase DLA's storage requirement by 2 MCF.

d. *Maximizing Cube Utilization*. This action will increase available space by 20 MCF through the use of proper storage aids (more vertical storage aids) and discontinue use of substandard storage facilities which are beyond economic repair. This additional storage volume is equal to 4 percent of DLA's covered storage capacity of March 1996.

e. *Material Outside Requires Inside Storage*. DLA plans to move to inside storage 18 MCF of material which is stored outside:

2. Baseline Inventory in Cubic Feet

DLA Headquarter's assumptions are reflected in estimates of DoD's baseline inventory for the next three years. The volume of material, in cubic feet (CF), which this baseline requires DLA to store is presented in Table 4.

Table 4. DoD Baseline Inventory
(all numbers in 000's of CF)

Fiscal Year	DLA Inventory	Service Inventories	Total Inventory
1992	303,000	328,000	631,000
1993	244,000	297,000	541,000
1994	209,000	241,000	450,000
1995	202,000	238,000	440,000
1996 (est)	192,000	238,000	430,000
1997 (est)	169,000	240,000	409,000
1998 (est)	161,000	244,000	405,000
1999 (est)	153,000	247,000	400,000
2000 (est)	145,000	250,000	395,000
2001 (est)	138,000	254,000	392,000

(Sears, 1996)

The DoD Baseline Inventory reflects a 37 percent reduction in DLA's storage requirement (in cubic feet). This 37 percent estimate is based on DLA and service inventory reductions coupled with the addition of new storage requirements. DLA and the services plan to reduce their inventories by 60 percent from 1992 - 2001. At the same time material needed to support new systems will add 19 percent to DLA's storage requirement (Sears, 1996). The combined effect is a projected 37 percent overall reduction in storage requirements (See Figure 4).

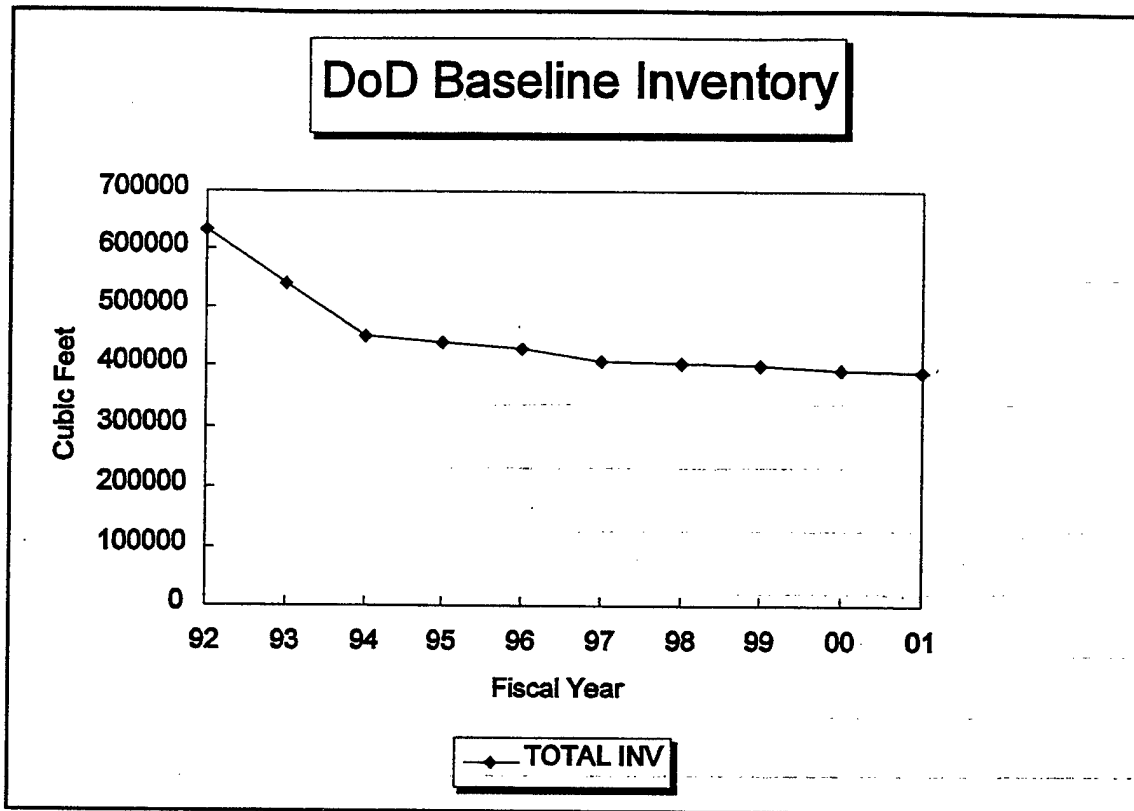


Figure 4. DoD Baseline Inventory
(all numbers in 000's of CF)

B. MILITARY FORCE STRUCTURE CHANGES

1. Overview

During the Cold War, U.S. defense planning focused on winning a large-scale war in Europe. As the Cold War wound down, there was a public expectation to reduce the size of the U.S. military and spend the resulting "peace dividend" on social concerns at home. As a result, the latter half of the Bush administration (1990-1992) saw the implementation of the "Base Force" as the planned force structure. It did not last very long because soon after he was elected, President Clinton, charged Secretary of Defense, Les Aspin, with conducting a Bottom-Up Review (BUR) of the military. The BUR was

completed in 1993 and remains the basis for the U.S. military force structure of the foreseeable future. (Ippolito, 1994, pp. 58-96)

The highlights of what the BUR means to the military in Table 5. The remainder of this section will describe the impact on the individual services in greater detail.

Table 5. Overview of U.S. Military Force Structure FY 1995 - 1999

	End FY 1995	End FY 1996	BUR-Based Plan End FY 1999
Army			
Active Divisions	12	10	10
National Guard Divisions	8	8	5
Navy			
Aircraft Carriers	11/1	11/1	11/1
Airwings (AC/RC)	10/1	10/1	10/1
Attack Submarines	85	80	45-55
Ships	373	359	346
Air Force			
Active Fighter Wings	13	13	13
Reserve Fighter Wings	8	7	7
Bombers	219	201	178
Marine Corps			
Active Personnel End Strength	174,000	174,000	174,000
Reserve Personnel End Strength	42,000	42,000	42,000

FY 1995 numbers (Perry, 1995, p. 31) except Bombers (Perry, 1995, p. 205)
FY 1996 and BUR 1999 numbers (Perry, 1996, p. 2.6)

The following notes explain the data in Table 5.

- a. 15 brigades of the National Guard Divisions at the end of FY 1996 have been designated Enhanced Brigades.
- b. National Guard Divisions at the End of FY 1999 will consist of 42 Brigades and 15 Enhanced Brigades.
- c. Dual entries in the table show data for active/reserve forces, except for carriers, which depicts active/operational reserve carriers.

The military force structure reductions planned for FY 1996 - FY 1999 are important to our study because they represent potential material returned to the military's supply system for DLA to store. As units are deactivated they turn in to the nearest DoD stock point any ready for issue (A-condition) material held by the unit's supply department. The returned material saves DoD money because it can be used by any requesting active unit rather than being destroyed. We are concerned with the volume of returned material DLA can expect to receive in the next three years.

2. Army

In FY 1996 the Army will complete its last major transition to the force structure defined in the BUR. On 25 April 1996 the 24th Infantry Division was deactivated and was replaced at Fort Stewart, GA, by the 3rd Infantry Division (Ft. Stewart Webpage, 1996). The 3rd Infantry Division was formerly stationed in Germany. This action reduced the Army to the BUR mandated ten divisions. The remaining divisions will include one airborne, one air assault, two light infantry, and six heavy (armored and mechanized) divisions. (Perry, 1996. p. 18.3)

Army modernization programs for the next three years consist of upgrading existing systems. This includes the Abrams tank upgrade, Bradley fighting vehicle upgrade, and the Army Tactical Missile System (ATACMS) Block 1A. (Perry, 1996, pp. 18.10 - 18.11)

3. Navy

Over the next three years the Navy will continue its transition to the force levels specified by the BUR. From mid- FY 1996 through FY 1999 the Navy will decommission 60 ships and commission 27 ships. By decommission we mean ships that will be placed either out of commission in reserve (OCIR), out of service in reserve (OSIR), in commission in reserve (ICIR), stricken (STRIKE), or sold to another country via foreign military sales (FMS). We will not include as decommissioned those warships transferred to the Naval Reserve Force (NRF) or auxiliary ships transferred to the Military Sealift Command Naval Fleet Auxiliary Force (MSC NFAF). The total number of ships being decommissioned from mid-FY 1996 through FY 1999 are listed in Table 6.

Table 6. Total Number of U.S. Navy Ship Decommissionings

Ship Status	Last half of FY 1996	FY 1997	FY 1998	FY 1999
OCIR/OSIR	6	1	6	5
ICIR	2	8	8	9
STRIKE	4	0	3	3
sold via FMS	5	0	0	0

(Worcester Polytechnic Institute, 1996)

Over the next three years, changes to the aviation arm of the Navy will be limited to the retirement of A-6 attack bombers by the end of FY 1997 and the purchase of ten additional F/A-18 fighter/attack aircraft in FY 1996. (Perry, 1996, p. 20.5)

4. Air Force

As of mid-FY 1996, the Air Force completed the downsizing required by the BUR (Pomeroy, 1996). The Air Force maintains a force structure of 20 fighter wing equivalents (FEWs), up to 181 long-range bombers, and 450-550 inter-continental ballistic missiles (ICBMs) (Perry, 1996, D-1).

The Air Force has several programs that will field additional units over the next three years to ensure that it maintains "Air Dominance." This includes procurement of thirteen B-2 bombers, nine C-17 cargo planes, ten F-15 fighters, and ten F-16 fighters, and ten Joint Surveillance and Target Attack Radar System (JSTAR) aircraft. (Dudney, 1996, pp. 19-20)

5. Marine Corps

Prior to FY 1996, the Marine Corps force structure attained the level mandated by the BUR. No changes are planned through FY 1999. Ongoing Marine Corps acquisition efforts thorough FY 1999 are limited to the upgrade of existing systems. (Perry, 1996, pp. 2.13 - 2.15)

C. MATERIAL RETURNED TO DLA DUE TO FORCE STRUCTURE CHANGES

1. Overview

From mid-FY 1996 through FY 1999, the services will make several force

structure changes that impact DLA's Distribution Directorate. Many of the changes were taken into account by DoD when the baseline inventory was established. This includes the return of Army material from Europe such as when the 3rd Infantry Division relieved the 24th Infantry Division at Fort Stewart, Georgia in April 1996.

The baseline, however, does not contain estimates for material returned by decommissioned ships or deactivated aircraft squadrons (Sears, 1996). The Air Force and Navy have reached their BUR mandated aircraft levels and are not required to deactivate additional squadrons. Therefore, we will consider that over the next three years the only changes from the DoD baseline inventory will be due to decommissioned Navy ships.

2. Navy

The type of decommissioning that a ship undergoes determines whether or not material will be offloaded or retained on board. Of the four different ship decommissioning types; OCIR/OSIR, ICIR, STRIKE, and FMS; only STRIKE results in the offload of material. The OCIR/OSIR and ICIR actions are commonly referred to as placing a ship in "mothballs," and the parts remain on the ship. (Gale, 1996)

Our measure for the volume of the spare parts (material) on a ship type is the average number of lifts offloaded from previously decommissioned ships. For surface ships, a lift could be either a triwall (4-foot cube cardboard boxes) or a pallet. For submarines a lift will always be a triwall. We assume that the volume of all lifts is: 64 cubic feet (CF). This is based on a 4ft X 4ft X 4ft average lift. The lift numbers and estimated volumes for selected ship types are listed in Table 7.

Table 7. Number of Returned Material Lifts and Resulting Volume by Decommissioning Ship Type

Ship Type	Number of Lifts	Volume of Material (CF)
Carrier (CV)	1,750	112,000
Amphibious Ship (LPH)	970	62,080
Tenders (AD, AS)	1,250	80,000
Auxiliary (AOR)	665	42,560
Surface Combatant (CGN, FFG)	450	28,800
Submarine (SSN)	31*	1,984

(Pannell, 1996)

* (Sheldon, 1996)

To estimate the maximum volume of the material returned to DLA for storage, we multiply the volume in Table 7 by the number of ships being decommissioned and classified for STRIKE in any given fiscal year. This will be the greatest volume of material DLA can expect to receive from ship decommissionings in any given fiscal year, because only stricken ships have their material offloaded. Individual ship decommissionings are classified for other than the current fiscal year, so are summarized by ship type. Table 8 presents the ship types that the Navy will STRIKE by fiscal year. Table 9 presents the maximum volume of material we expect to be offloaded from these ships by fiscal year.

Because the Army, Air Force, and Marine Corps have completed their BUR mandated drawdowns, the last line in Table 9 represents the total estimated volume of material returned to DLA by deactivated forces through FY 1999. We next subtract this total and the DoD Baseline Inventory from DLA's storage capacity to calculate the excess or shortfall in DLA storage space.

Table 8. Ships Scheduled for STRIKE by Type and Fiscal Year

Ship Type	Last half of FY 1996	FY 1997	FY 1998	FY 1999
Amphibious Ship (LPH)	0	0	2	0
Tenders (AD, AS)	1	0	0	1
Submarine (SSN)	3	0	1	2

Last half of FY 1996 numbers (CNO N80, 1996)

FY 1997 - FY 1999 numbers (Worcester Polytechnic Institute, 1996)

Table 9. Expected Material Offloads (in CF) by Ship Type and Fiscal Year

Ship Type	Last half of FY 1996	FY 1997	FY 1998	FY 1999
Amphibious Ship (LPH)	0	0	124,160	0
Tenders (AD, AS)	80,000	0	0	80,000
Submarine (SSN)	5,952	0	1,984	3,968
Total	85,952	0	126,144	83,968

V. AVAILABLE STORAGE SPACE VERSUS STORAGE REQUIREMENTS

In this chapter we will compare the three driving forces affecting DLA's storage operations: Loss of storage space due to depot closures, DoD's baseline inventory requirements, and additional storage requirements as material is returned due to military downsizing.

Over the next three years DLA's Distribution Directorate will have to cope with losing storage space at depots closed by BRAC 1993 and BRAC 1995 at the same time they are absorbing material returned for storage as a result of military downsizing. This will go on against the backdrop of DoD's baseline inventory.

The combined impacts of lost depot space, the DoD baseline inventory, and returned material are summarized in Tables 10 and 11. Table 10 displays the total excess/shortfall in DLA storage space in the case of the earliest possible closure of depots selected by the BRAC. Table 11 displays the same information using the latest closure of depots selected by the BRAC. Figure 5 presents both the earliest and latest closure capacities versus DoD's storage requirements. In each case, the storage excess (shortfall) values are obtained using the formula:

$$\begin{array}{rcccl} \text{Excess/(Shortfall)} & & \text{DLA} & \text{DLA} & \text{DOD Baseline} & \text{Material Returned} \\ \text{in DLA} & = & \text{ACF} & + & \text{Inventory} & - & \text{by Deactivated} \\ \text{Storage Space} & & \text{(Covered)} & & \text{Requirement} & & \text{Forces.} \\ & & & & & & \text{(Open)} \end{array}$$

In this formula the unit of measure is cubic feet (CF). Occupied open ACF is used rather than total open ACF because it reflects the maximum desirable level of outside storage.

DLA is making efforts to return to covered storage 18 MCF of material currently stored outside.

**Table 10. Comparison of Factors Impacting DLA Storage
Earliest Closure of Depots (numbers are in 000s)**

	End of FY 1996	End of FY 1997	End of FY 1998	End of FY 1999
DLA ACF (Covered)	563,710	456,344	415,825	415,825
DLA ACF (Open Occupied)	94,370	79,389	71,543	71,543
DoD Baseline Inventory Requirements in CF	430,000	409,000	405,000	400,000
Material Returned by Deactivated Forces in CF	86	0	126	84
Excess/(Shortfall) of CF in DLA Storage Space - earliest closure	227,994	126,733	82,242	87,284
Percent of Capacity Utilized	65%	76%	83%	82%

**Table 11. Comparison of Factors Impacting DLA Storage
Latest Closure of Depots (numbers are in 000s)**

	End of FY 1996	End of FY 1997	End of FY 1998	End of FY 1999
DLA ACF (Covered)	563,710	495,051	479,871	479,871
DLA ACF (Open Occupied)	94,370	85,572	85,351	85,351
DoD Baseline Inventory Requirements in CF	430,000	409,000	405,000	400,000
Material Returned by Deactivated Forces in CF	86	0	126	84
Excess/(Shortfall) of CF in DLA Storage Space - latest closure	227,994	171,623	160,096	165,138
Percent of Capacity Utilized	65%	70%	72%	71%

Table 10 assumes all depots selected for closure by BRAC will be closed by the end of FY 1999, while Table 11 is based on some of the depots being open until the end of FY 2001, corresponding to the earliest and latest closure projections. This is the reason for the difference in FY 1999 values between the two tables.

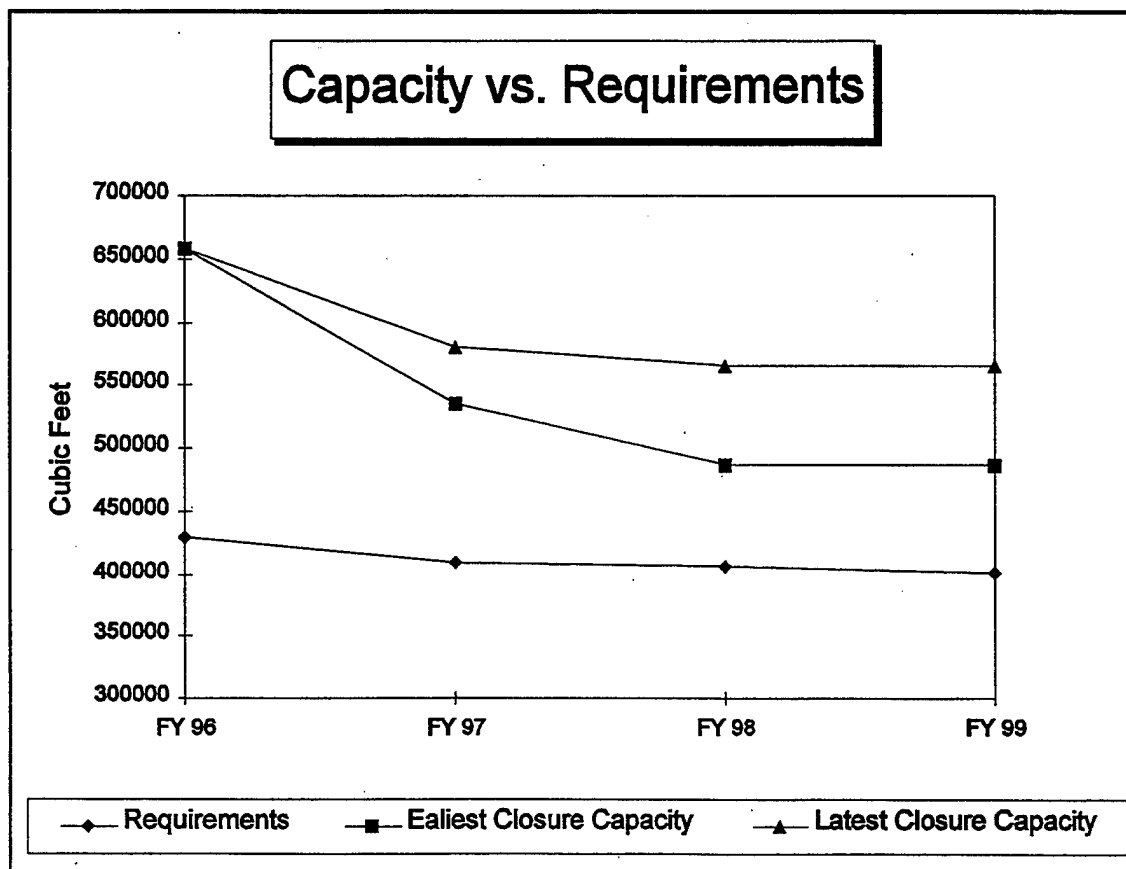


Figure 5. Capacity vs. Requirements

Based on our estimates, for each of the next three fiscal years DLA will have sufficient excess storage capacity. At the low point in FY 1998 the excess will only be 82,242,000 CF (with the earliest BRAC closure scenario). This is roughly equal to the covered storage at the Defense Depot Susquehanna, PA. Looking at it DLA system-wide

it is 17 percent excess storage capacity.

This excess capacity is significant because it means that if DLA and the individual services were not able to reduce their inventories below the FY 1996 level of 430 MCF, then DLA would still have excess storage capacity of 57 MCF (12 percent of capacity) at the end of FY 1998.

The DLA Distribution Directorate Storage Policy Team's warehouse capacity target is a maximum of 85% utilization. The utilization rates in Tables 10 and 11 range from a high of 83 percent in FY 1998 for earliest depot closure rate to low of 65 percent in FY 1996 for both closure rates. Thus, for both closure rates the capacity utilization rate is near the goal for all fiscal years. Figure 6 presents capacity utilization data for FY 1996 - FY 1999.

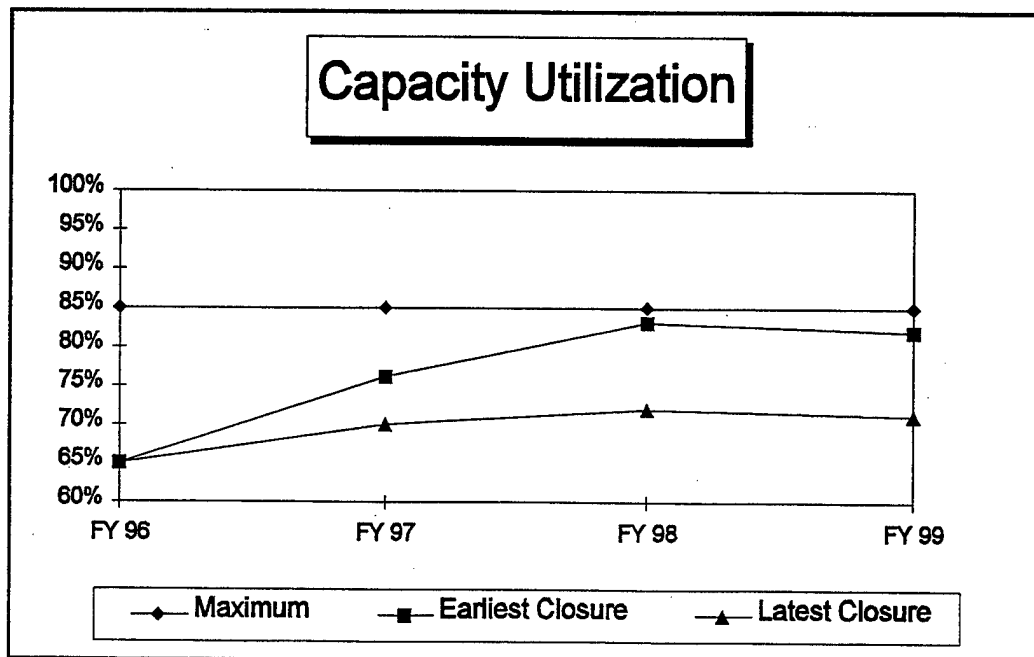


Figure 6. Capacity Utilization

VI. SUMMARY

A. SUMMARY

The purpose of this research was to determine the effect on DLA's storage system of the twin downsizing forces – lost storage space due to BRAC and material returned by deactivated and decommissioned units. To calculate the expected excess for storage space for the next three years, we determined the amount of storage space available to DLA over the next three years, DoD's baseline inventory level for DLA, and the amount of material to be returned from deactivated/decommissioned units.

Our results show that by the end of FY 1999 there will be a 27-29% reduction in DLA's storage capacity (depending on whether one measures cubic feet or square feet). Since 1992, when DLA obtained control of the military's 32 supply depots, there has been an aggressive effort to reduce waste by cutting the infrastructure. In recent years the BRAC process, with DLA Headquarters playing an active role, has closed or slated for closure 15 of those depots. By FY 2001 DLA will manage only 17 CONUS supply depots.

A look at the DoD baseline inventory level and DoD force structure changes yielded a worst case quantity of these materials which DLA will be required to store for the military over the next three years. The DoD baseline inventory level decreases slightly during each of the years examined. It falls from 430 MCF in FY 1996 to approximately 400 MCF in FY 1999. Looking at the impact of force structure changes for FY 1996 through FY 1999 we found that the Navy is the only service continuing its transition to the levels mandated by the 1993 BUR. (The other services completed their downsizing to

reach their BUR levels prior to mid-FY 1996.) The potential volume of material returned by ships decommissioned and stricken (in STRIKE status) was relatively small with a high point of at most 126,144 CF in FY 1998.

The comparison of available DLA storage space to DoD storage requirements revealed that over the next three years DLA will have excess storage capacity each year. In the worst case scenario, earliest depot closure and all the returned material is accepted by DLA, the excess capacity was a low of 82 MCF in FY 1998. The FY 1998 excess is 17 percent of DLA's total capacity and is an adequate safety margin to accommodate variability in future DoD storage requirements.

DLA is not vulnerable to the assumptions that make up the DoD Baseline Inventory. Even if DLA and the services are unable to reduce inventories below current levels, they will have an excess capacity of 57 MCF (12 percent of capacity) in the most limiting year (FY 1998). This results in 88 percent warehouse space utilization. Because the maximum warehouse capacity goal is 85 percent, warehouse utilization in the next three years will only marginally exceed DLA's limit, even in the worst case. Based on our analysis, DLA should not close any more warehouses than are currently scheduled to close.

The excess capacity ranges from a low of 12 percent to a high of 35 percent based on depot closure rates and efforts to downsize inventory requirements. If depots are closed at the latest possible date and inventory is downsized by DLA and the services, the excess capacity high point is 35 percent in FY 1996 and drops to 29 percent in FY 1999. The variance of excess capacity between the two closure rates is dramatic.

All of the depots selected for closure by the BRAC will have to be closed by the end of FY 2001. This means that by FY 2001 DLA's capacity utilization rate will be the same for the latest depot closure option as the FY 1999 value for the earliest depot closure option. Thus, by FY 2001 DLA will be very close to the capacity utilization upper limit of 85%. Therefore, DLA will be close to the optimum level of excess capacity and should not close any more depots.

B. RECOMMENDATIONS

We recommend that DLA change storage requirements calculations to include material returned by decommissioned and deactivated units. We recommend DLA use material offload quantities given in Table 7 for decommissioned, stricken Navy ships. DLA should coordinate with the Army, Air Force, and Marine Corps to develop estimates for material returned by deactivated units of these services.

C. AREAS FOR FURTHER RESEARCH

Recommendations that directly build on this thesis are related to developing material volume measures, material disposal from decommissioned ships, and inventory requirements drivers. They are:

- a. Develop exact measures of the volume of supply system material held by major units of each service. For example, how many spare parts are carried on each class of Navy ship in their Coordinated Shipboard Allowance List (COSAL) and Aviation Coordinated Allowance List (AVCAL) and how many cubic feet do they take up. For the Army and Marine Corps, one might use the division level as the major unit and for the Air Force use the wing level. This would assist DLA stock policy managers in estimating the

volume of material held by deactivated and decommissioned units.

b. Develop a model of the decision and physical processes used by the Navy to dispose of material from decommissioned ships. For example, what are the steps in the thought process and how is material actually transferred to DLA, Defense Reutilization Marketing Office (DRMO), and other Navy activities. Also develop volume measures for the different types of material. This would include as a minimum: supply system stock, operating space items, general use consumables, and office equipment. This model would help the Navy teach supply personnel how to conduct a decommissioning and would improve DLA - Navy communication.

c. Research the storage space requirements placed on DLA in support of former U.S. military weapon systems now owned by foreign governments. For example, DLA stores parts required to support former KNOX class frigates bought by Turkey and fighter aircraft sold to Japan. If the volume of these parts is large, then it will benefit DLA material managers to know the amount of material that cannot be removed from inventory even though it may be obsolete for U.S. military forces.

d. Research the impact of military downsizing and the BRAC process on the DLA Material Management Directorate's stock positioning policy. DLA is constantly moving stock due to BRAC closing depots. How much material has been moved and how much has it cost DoD to move it? This would help future comptrollers estimate the financial impact of depot closures.

e. Develop a model of the process DLA's Distribution Directorate uses to redistribute the material stored at depots closed by the BRAC process. This would help

DLA to improve the process and would help other material managers benefit from DLA's experience.

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